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Heat-bonding blade and heat-bonding apparatus.

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Description

The present invention relates to a heat-bonding blade according to the preamble of claim 1 and to a heat-bonding apparatus according to the preamble of claim 2.

A known heat cutting/welding blade, capable of thermally heat-cutting superposed non-woven cloth sheets of a thermoplastic resin and heat-bonding the cut edges of the sheets, employs an isosceles triangular cutting edge portion which is heated by, for example, an electrical heating coil. The cutting edge is advanced into the layers of the thermoplastic resin sheets while cutting these sheets and thermally fusing the cut edges so as to heat-bond the superposed sheets.

On the other hand, a heat-bond blade has been known which is capable of pressing an end surface of a heated plate to sheets to be welded so as to fuse and bond both sheets without cutting them. This type of welding blade apparatus can perform heat-seal of non-woven cloth sheets formed by film-laminate process. Various arrangements of sealing blades are disclosed in US-A-3438173 and US-A-4384442 which disclose the provision of movable pressing members on either side of a blade.

A heat-bonding apparatus having the following features also has been known for heat-bonding sheets without cutting. This known apparatus is intended for use in forming a sack by welding non-woven cloth sheets formed by thermoplastic resin. As shown in Fig. 9 of the accompanying drawings, this known apparatus employs a disk-shaped heat-bonding blade 40 which is knurled at its peripheral surface as at 41. This heat-bonding blade 40 is adapted for cooperating with an anvil roll 42 having a similar structure. In use, the heat-bonding blade 40 is heated by means of, for example, an electric heater coil. The welding blade 40 is then made to roll on the sheets of the thermoplastic resin so that the superposed sheets are heated and fused so as to be welded together. Similar apparatus is disclosed in US-A-4717372 which is intended to form a discontinuous weld.

This known heat-bonding blade apparatus has the following problems. Namely, when this known apparatus is used for the purpose of melt-cutting and bonding of non-woven cloth sheets of polypropylene, the bonded portion usually exhibits inferior appearance and low bonding strength. Namely, the processing conditions for obtaining both good appearance and high bonding strength are extremely limited, and only well skilled persons could conduct the processing under such restricted conditions. In addition, the production efficiency was extremely low.

In order to avoid this problem, it has been a common measure to laminate a film having high bondability, e.g., a polyethylene film, to the non-woven cloth of the polypropylene sheet, so as to enable an easy cutting and sealing. This countermeasure is quite uneconomical.

Another problem encountered with the conventional heat-bonding blade apparatus is that the bonding strength is insufficient when three or more layers are superposed and heat-sealed, though this known apparatus provides appreciable cutting and bonding effect when used for a pair of sheets. This problem is serious particularly when a non-woven cloth sheet is used as one of the constituent elements of the laminated sheet structure.

Furthermore, the known heat-bonding blade apparatus could not provide acceptable appearance and bonding strength when used for heat-bonding of a pair of sheets of non-woven cloths which have no film laminated thereon.

In order to overcome the above-described problems of the prior art, the present invention is aimed at providing an improved heat bonding blade/apparatus.

Accordingly the present invention provides a heat-bonding blade having an edge for heat-bonding two or more thermoplastic resin sheets superposed on one another without heat-cutting them, the edge of said blade being provided with a contact surface contactable with the uppermost one of said thermoplastic resin sheets, said contact surface being embossed so as to have a multiplicity of emboss projections and wherein said blade comprises a pressing member having a lower end and which is provided on at least one side of said blade for pressing said thermoplastic resin sheets sufficiently to cause heat-bonding when said edge of said blade is pressed into said sheets, so that said sheets are pressed at a predetermined pressure by said at least one pressing member during heat-bonding, characterized in that the bonding area ratio given by the following formula ranges between 20 and 90%.

\[
\text{[(total area of emboss projections)/(total area of contact surface)]} \times 100
\]

Another aspect of the present invention provides a heat-bonding apparatus comprising a rotatable heat roll heated by a heater provided on the outer periphery thereof with at least one heat-bonding blade and a rotatable anvil roll for cooperating with said heat roll so as to clamp therebetween a plurality of superposed thermoplastic resin sheets to be heat-bonded together, wherein said heat-bonding blade has an edge providing a contact surface contactable with the uppermost one of the superposed thermoplastic resin sheets, said contact surface being embossed to have a multiplicity of emboss projections and wherein said
blade comprises a pressing member having a lower end and which is provided at least on one side of said blade for pressing said thermoplastic resin sheets sufficiently to cause heat bonding when said edge of said blade is pressed into said sheets so that said sheets are pressed at a predetermined pressure by said at least one pressing member during heat-bonding, characterized in that the bonding area ratio given by the following formula ranges between 20 and 90%  

\[
\left(\frac{\text{total area of emboss projections}}{\text{total area of contact surface}}\right) \times 100.
\]

Particular embodiments of the invention are disclosed in the dependent claims 3 to 10.

This blade and apparatus is capable of bonding three or more superposed sheets of thermoplastic resin, particularly non-woven cloth sheets of polypropylene with an attractive appearance and high strength of the welded portion.

It is also possible to adapt the apparatus to selectively and continuously conduct bonding of sheets of thermoplastic resin, particularly non-woven cloths of polypropylene, or a laminate sheet structure having three or more sheets, with heat-cutting of the sheets.

The pressing member may be provided in duplicate: namely, one on each side of the blade member. Such an arrangement will produce a greater effect in pressing and fixing the sheets. The arrangement having having the pressing member only on one side of the blade member is suitable for use in the case where the edges of the sheets are to be bonded.

The pressing member, which is provided on one or each side of the blade member, is preferably made of a heat-resistant elastic material.

Examples of such a heat-resistant elastic material are heat-resistant rubber, heat-resistant elastomer, heat-resistant elastic foam or the like. Such an elastic material used as the pressing member will provide a greater effect in pressing and fixing the sheets.

It is also possible to arrange such that the pressing member made of a heat-resistant material is mounted for movement towards and away from the cutting edge may also be urged by a suitable urging means such as a spring towards the cutting edge of the blade. In such a case, a metallic plate, ceramics plate or the like member can be used as the heat-resistant member.

Preferably, the pressing member is cooled by a suitable cooling means. The cooling means may be a pipe or the like member laid along the pressing member and capable of passing a cooling heat medium such as water. The provision of such a cooling means is essential when the pressing member is a metal plate. However, when a heat-resistant rubber or a ceramics is used as the material of the pressing member, the cooling means may be dispensed with if the pressing member exhibits so small heat conductivity that the sheets are not molten when the pressing member is pressed onto the sheets.

Any other type of cooling means, capable of externally cooling the pressing member or internally by circulating water or the like medium inside the pressing member, may be used in place of the above-described type of cooling means.

The cooling of the pressing member by means of the cooling means makes it possible to avoid defects such as uneven cooling of the molten resin, variation of direction of contraction and so forth (such unevenness and variation are serious particularly when the sheets are non-woven cloths), during solidification of the portions fused and heat-bonded by the heat-cutting/bonding blade, thus stabilizing the state of cooling and contraction of the sheet.

It is possible to arrange such that the pressing member is movable towards and away from the cutting edge and means are provided for fixing the pressing member at a desired position. Such an arrangement enables the distance between the lower end of the pressing member and the cutting edge to be set in accordance with the thickness of the laminate sheet structure to be bonded.

The heat-bonding blade of the invention has a bond surface ratio which ranges between 20 and 90%, though more preferably is between 30 and 60%.

Values of the bonding area ratio below 20% tend not to provide sufficient bonding strength so that a sack formed from the bonded sheets will exhibit impractically low level of hermetic sealing power. On the other hand, a value of the bonding area ratio greater than 90% will impair the advantage of the embossing because in such a case, the embossed contact surface is regarded as being material equivalent to the smooth surface. The emboss projection can have conical or pyramidal form of triangular, square or other polygonal cross-section. The emboss projections may be arranged along the cutting edge or at an inclination to the cutting edge.

In the heat-bonding blade of the present invention, it is necessary that the blade member is heated to a temperature above the melting point of the thermoplastic resin sheet. The temperature should be changed in accordance with the type of the sheets to be bonded.

Pressing of the blade member of the heat-bonding blade onto two or more thermoplastic resin sheets superposed one on another, the contact surface of the cutting edge is pressed to depress the sheet surface. Meanwhile, the lower edge of
the pressing member is pressed onto the portion of the sheet along the edge of the blade. In consequence, the contact surface of the cutting edge of the blade member heats and melts the sheets so as to bond these sheets together. Since the sheets are pressed by pressing member, the molten resin does not flow nor spread laterally. The contact surface emboss projections transmit heat so as to heat-bond the sheet, while other portion presses and holds the sheet to maintain the shape of the sheets.

The present invention also provides a heat-bonding apparatus making use of a blades of one of the types mentioned above.

The heat-bonding apparatus of the present invention is capable also of selectively conducting a heat-bonding with cutting as well as a heat-bonding without cutting of the sheets by appropriate setting of the temperatures of the anvil and heat roll.

The apparatus comprises a heat seal roll apparatus which is composed of a heat roll having a heat-bonding blade on the outer peripheral surface thereof, and a support roll which is mounted rotatably such that a plurality of sheets of thermoplastic resin to be bonded can be clamped between the heat roll and the support roll. The support roll has a peripheral surface which is contactable at its outer peripheral surface with the edge of the heat-bonding blade on the heat roll.

It is possible to cover the outer peripheral surface of the support roll with a heat-resistant elastic material so that the sheets can conveniently be held between the support roll and the pressing member. Examples of the material suitable for use as the heat-resistant elastic material covering the support roll are heat-resistant rubber, a heat-resistant elastomer, a heat-resistant elastic foaming member or the like.

The heat-bonding blade of this heat-bonding apparatus, when used for the selective cutting and heat-bonding of thermoplastic resin sheets, has to be heated to a temperature lower than the melting point of the thermoplastic sheets. On the other hand, when the apparatus is used only for the purpose of heat-bonding without cutting, the heat-bonding blade has to be heated to a temperature which is slightly lower than the temperature to which the blade is heated during the cutting/bonding, but the anvil is heated to a higher temperature. These temperatures are determined and changed according to the material of the sheet to be bonded. The blade pressure may also be adjusted.

When the sheets are cut and heat-bonded at their edges, it is preferred that a take-up roll capable of taking-up the cut end portions of the sheets is used simultaneously with the operation of the apparatus.

Thus, the temperature of the heat-bonding blade unit varies according to the kind of the thermoplastic resin sheets to be bonded, but the temperature of the blade when used for heat-bonding is preferably lower than the temperature of the same in the cutting/heat-bonding mode by a predetermined amount, e.g., 30 to 70 °C, more preferably between the softening point of the thermoplastic resin sheets and the melting point of the same. On the other hand, the temperature of the anvil (lower blade) during the heat-bonding is preferably set at a level which is higher by a predetermined amount, preferably 70 to 100 °C, than the temperature of the same in the cutting/heat-bonding mode. The pressure exerted by the blade is determined at such a level as not to cause the thermoplastic resin sheets to be cut. This pressure also is determined and changed in accordance with the physical properties of the thermoplastic resins sheets to be bonded.

Whether the thermoplastic resin sheets are cut and heat-bonded or merely heat-bonded is determined by the temperatures to which the blades are heated and the pressure exerted by the blade. For instance, it is possible to effect only the heat-bonding even when the blade has been heated to a level higher than the melting point of the thermoplastic resin sheet, provided that the pressure exerted by the blade is sufficiently low.

It is possible to effect only the heat-bonding by setting the temperature of the heat-bond blade to a level below the temperature of the anvil (lower blade) while determining the pressure exerted by the heat-bond blade at such a level as not to cause the thermoplastic resin sheets to be cut.

In the heat seal roll apparatus of the present invention, the pressing member presses and holds the plurality of sheets of the thermoplastic resin sheets superposed in layers, so that the cutting and heat-bonding are conducted without fail. In addition, the feed of the sheet by the rotation of the roll can be effected smoothly without fail by virtue of the fact that the pressing member presses the sheet.

The heat-bond blade and heat-bond apparatus or the present invention can conveniently used for various kinds of heat-bonding thermoplastic resin sheets and films, particularly sheets of non-woven cloth, more particularly sheets of spun-bond non-woven cloth sheets. It is possible to heat-bond such sheets of the same material, or sheets of different types and materials of thermoplastic resin may be bonded. Each of the sheets to be bonded may be a single-layered sheet or a laminate sheet. Bonding is also possible with a laminate sheet which includes a layer of a material other than a thermoplastic resin, e.g. an aluminum foil.
The invention will be further described by way of example in the following description given with reference to the accompanying drawings, in which:

Fig. 1 is a schematic illustration of a sack producing apparatus employing the first-type of heat-bonding blade of the present invention;
Fig. 2 is an enlarged view of a heat-bonding portion;
Fig. 4 is a sectional view of a fourth example.

Figs. 3, 5 and 6 are illustrations of embodiments of a heat-bonding blade unit of the present invention, in which:

Fig. 3 is a sectional view of a first example;
Fig. 5 is a sectional view of a second example; and
Fig. 6 is a plan view of a contact surface of the second example of the heat-bonding blade;
Fig. 7 is an illustration of an embodiment of further type of heat-bonding blade of the present invention;
Fig. 8 is an enlarged view of the heat-bonding section of the embodiment; and
Fig. 9 is a conventional heat-plate type sealing blade.

Preferred embodiments of the present invention will be described hereinafter with reference to the drawings. For an easier understanding of the present invention, the description will be first given of a sack producing apparatus which is shown in Figs. 1 and 2.

In this sack producing apparatus, a sheet is folded double about a folding mandrel 11 and the folded sheet is fed into the nip between a pair of feed rolls 12, 12 so that the folded portion constitutes the bottom of a sack. Then, in a subsequent heat-cutting/sealing section 13, the sheet is heat-cut and bonded so that both sides of the sack are sealed. The thus-formed sack is taken-up by the take-up roll 14 and ejected into a box 16 by means of a chute 15.

The heat-cutting/sealing section 13 has an anvil 21 which supports the sheets to be cut. An endless silicon belt conveyor 22 is adapted to be moved along the anvil 21 so as to intermittently feed the laminated sheet. A heat-bonding blade 2 in accordance with the present invention is installed above the path of the sheet for cooperation with the anvil 21.

Example 1

Before describing the blade of the invention, for ease of understanding Fig. 3 shows a heat-bonding blade, designed for the purpose of heat-bonding thermoplastic resin sheets without cutting them which has a built-in heater 1 and is provided with a flat contact surface 2a on the end thereof. At the same time, pressing members 3, 3 are fixed to both side surfaces of the cutting blade 2 along the cutting edge of the blade 2. The pressing members 3 are made of heat-resistant silicone rubber. The distance between the lower end of the pressing member 3 and the edge of the blade is determined such that the pressing members 3 are capable of lightly pressing a laminate of sheets of thermoplastic resin to be bonded at bottom sides of the edge of the blade, when the edge of the blade has cut into the laminate of the sheets. A cooling pipe 5 as cooling means is laid along each pressing member 3 and cooling water was circulated through this pipe.

Fig. 4 shows an example of a different type of blade but which illustrates how the heat-resistant rubber blocks serving as pressing members 3 can be substituted by ceramics blocks. Springs as urging means 4 are disposed to act between the ceramics blocks and the heat block. Although not shown, it is possible to arrange such that pressing members are constituted by metallic plates secured to both sides of the blade and urged by springs towards the edge of the blade by means of springs.

Sacks were formed under the following conditions, by using the heat-bonding blade 2 of the type shown in Fig. 3, and the appearance and the strength of the seals were evaluated. Two types of original sheets having different strength levels, each being a polypropylene spun-bond non-woven cloth sheet of long fibers of 2 denier and having a weight per unit area of 25.70 g/m² and thickness of 0.2 to 0.3 mm, were used. Two sheets of each type were superposed and heat bonded to form a sack.

The results are shown in Table 1. In Table 1, terms "longitudinal" represents the direction of drawing off of the spun material fibers received and drawn by a movable trapping surface during production of a spun-bond non-woven cloth, while "transverse" represents the direction perpendicular to the direction of the drawing off. This apparatus effects "longitudinal seal", with the blade set in the direction perpendicular to the longitudinal direction as explained before. The sacks after the sealing showed attractive appearance.

(Example 2)

As shown in Fig.5, the heat-bonding blade of the invention has a construction substantially the same as that shown in Fig. 3, except that the contact surface 2a is embossed to have a multiplicity of embossing projections 2b. Each the embossing projection has a square pyramidal form cut at its top. This, the size of the cross-section of the emboss projection at its base portion is a in length and b in width, while the top surface is b in length and b in width. The height of the emboss projection
is c. The contact surface 2a thus had a heat-bonding area ratio of 30%.

Other portions are materially the same as Example 1. The results are shown in Table 1. It will be seen that the heat-bonding is effected only at spots pressed by the emboss projections, while other portions of the contact surface merely serve to hold the sheets. The resin molten under the spots pressed by the emboss projections 2b flow into the regions devoid of the emboss projections 2b, whereby a seal with an attractive appearance can be obtained. In this Example, the pressing effect produced by the pressing members 3 and the effects produced by the emboss projections 2b in cooperation provide better appearance and higher sealing strength of the heat-bonded portions.

(Comparison Example 1)

A sack was formed by using a conventional heat-bonding blade which is similar to that of Example 1 but lacks the pressing members 3 and the cooling means. The results are shown in Table 1. In Table 1, the pressing time longitudinal/transverse means the results of measurement of the strength of the heat bond effected by setting the blades of the respective Examples both in the longitudinal and transverse directions of the non-woven cloth. As will be understood from this table, this Comparison Example is very far from providing heat-seal strengths equivalent to those of the invention of this application, even when the pressing time in the transverse direction is increased three times and even when the pressure is increased.

<table>
<thead>
<tr>
<th>Sheet 2</th>
<th>Original sheet</th>
<th>Heat seal strength (kg/5cm wide)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pressure (kg/cm²)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longitudinal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>175/175</td>
</tr>
<tr>
<td>Ex. 1</td>
<td>250/250</td>
<td>1.0</td>
</tr>
<tr>
<td>Ex. 2</td>
<td>250/250</td>
<td>1.0</td>
</tr>
</tbody>
</table>

As shown in Fig. 7, the heat-bonding blade 2 of Example 3, designed for non-cutting heat-bonding,
has a built-in heater 1 and has a flat contact surface 2a on the end of the blade. The contact surface 2a is embossed to have a multiplicity of embossing projections 2b. Each the embossing projection has a square pyramidal form cut at its top. This, the size of the cross-section of the emboss projection at its base portion is a in length and a in width, while the top surface is b in length and b in width. The height of the emboss projection is c. The contact surface 2a thus had a heat-bonding area ratio of 30%.

Sacks were formed under the following conditions, by using the heat-bonding blade 2 of the type shown in Fig. 7, and the appearance and strength of the seal were evaluated. Two types of original sheets having different strength levels, each being a polypropylene spun-bond non-woven cloth sheet of long fibers of 2 denier and having a weight per unit area of 25.70 g/m² and thickness of 0.2 to 0.3 mm, were used. Two sheets of each type were superposed and heat bonded to form a sack.

The results are shown in Table 2. In Table 2, terms "longitudinal" represents the direction of drawing off of the spun material fibers received and drawn by a movable trapping surface during production of a spun-bond non-woven cloth, while "transverse" represents the direction perpendicular to the direction of the drawing off. This apparatus effects "longitudinal seal", with the blade set in the direction perpendicular to the longitudinal direction as explained before. The sacks after the sealing showed attractive appearance.

It will be seen that the heat-bonding is effected only at spots pressed by the emboss projections, while other portions of the contact surface merely serve to hold the sheets. The resin molten under the spots pressed by the emboss projections 2b flow into the regions devoid of the emboss projections 2b, whereby a seal with an attractive appearance can be obtained.

(Comparison Example 2)

Sacks were formed by using a conventional heat-bonding blade which is of the same type as that shown in Example 1 except that the emboss projections 2b are not formed. The results are shown in Table 2. As will be understood from this table, this Comparison Example is very far from providing heat-seal strengths equivalent to those of the invention of this application, even when the pressing time in the transverse direction is increased three times and even when the pressure is increased.

<table>
<thead>
<tr>
<th>Sheet 1 longitudinal strength (kg/cm²)</th>
<th>Sheet 2 longitudinal strength (kg/cm²)</th>
<th>Pressing time (sec)</th>
<th>Pressing temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>longitudinal/transverse 9.5/5.8</td>
<td>longitudinal/transverse 14.5/3.5</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Set temp. (°C)</td>
<td>Set temp. (°C)</td>
<td>Heat seal strength (kg/cm²)</td>
<td>Heat seal time (sec)</td>
</tr>
<tr>
<td>165/180</td>
<td>185/180</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Comp. Ex. 2</td>
<td>Ex. 3</td>
<td>2.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

In the heat-bonding blade and apparatus of the invention intended for heat-bonding thermoplastic resin sheets without cutting, the pressing members effectively press the sheets even when the sheets are bulky non-woven cloth sheets, so as to keep the fibers of the cloth in compacted condition along
the line of bonding. This type of blade, therefore, is suitable for heat-bonding two or more sheets of non-woven cloth, as well as multi-layered sheets having a non-woven cloth as a constituent, not to mention ordinary thermoplastic resin sheets, thus making it possible to obtain attractive appearance of the seal and high seal strength. These effects are enhanced by the providing emboss projections on the contact surface.

Further, the sheets can be heat-bonded only at spots corresponding to the emboss projections while other portions of the contact surface on the blade merely hold the sheets. In consequence, the resin molten under the spots is made to flow into the regions devoid of the emboss projections, thus offering excellent appearance and high bonding strength. In particular, this type of blade provides superior effect when used for heat-bonding of non-woven cloth sheets.

Claims

1. A heat-bonding blade (2) having an edge (2a) for heat-bonding two or more thermoplastic resin sheets superposed on one another without heat-cutting them, the edge (2a) of said blade being provided with a contact surface contactable with the uppermost one of said thermoplastic resin sheets, said contact surface being embossed so as to have a multiplicity of emboss projections (2b) and wherein said blade (2) comprises a pressing member (3) having a lower end and which is provided on at least one side of said blade for pressing said thermoplastic resin sheets sufficiently to cause heat-bonding when said edge (2a) of said blade is pressed into said sheets, so that said sheets are pressed at a predetermined pressure by said at least one pressing member during heat-bonding, characterized in that the bonding area ratio given by the following formula ranges between 20 and 90%:

\[
\text{\{total area of emboss projections\}/(total area of contact surface)} \times 100.
\]

2. A heat-bonding apparatus comprising a rotatable heat roll heated by a heater provided on the outer periphery thereof with at least one heat-bonding blade (2) and a rotatable anvil roll (21) for cooperating with said heat roll so as to clamp therebetween a plurality of superposed thermoplastic resin sheets to be heat-bonded together, wherein said heat-bonding blade (2) has an edge (2a) providing a contact surface contactable with the uppermost one of the superposed thermoplastic resin sheets, said contact surface being embossed to have a multiplicity of emboss projections (2b) and wherein said blade (2) comprises a pressing member having a lower end (3) and which is provided at least on one side of said blade for pressing said thermoplastic resin sheets sufficiently to cause heat-bonding when said edge (2a) of said blade is pressed into said sheets so that said sheets are pressed at a predetermined pressure by said at least one pressing member (3) during heat-bonding, characterized in that the bonding area ratio given by the following formula ranges between 20 and 90%:

\[
\text{\{total area of emboss projections\}/(total area of contact surface)} \times 100.
\]

3. A heat-bonding apparatus according to claim 2, wherein anvil roll (21) is covered at its outer peripheral surface with a heat-resistant elastic material.

4. A heat-bonding blade according to claim 1 or apparatus according to claim 2 or 3, wherein said pressing member (3) is provided on each side of said blade (2).

5. A heat-bonding blade according to claim 1 or 4 or apparatus according to any one of claims 2 to 4, wherein said pressing member (3) is made of a heat-resistant elastic material so that it can adapt itself to a variety of thicknesses of the superposed sheets by its elasticity.

6. A heat-bonding blade according to claim 1 or 4 or apparatus according to any one of claims 2 to 4, wherein said pressing member (3) is made of a heat-resistant material and is mounted for movement towards and away from the edge of said blade (2), said blade (2) further comprising urging means (4) for urging said pressing member (3) towards said edge of said blade (2).

7. A heat-bonding blade according to claim 1 or 4 or apparatus according to any one of claims 2 to 4, wherein said pressing member (3) is mounted for movement towards and away from the edge of said blade (2), said blade (2) further comprising means for fixing said pressing member (3) at a predetermined position.

8. A heat-bonding blade according to any one of claims 1 or 4 to 7, or apparatus according to one of claims 2 to 7, further comprising cooling means (5) for cooling said pressing member (3).
9. A heat-bonding apparatus according to one of claims 2 to 8, wherein said apparatus is operable selectively also in a heat-cutting/bonding mode in which it heat-cuts and heat-bonds said thermoplastic resin sheets, by selection of the heating temperature of said heat roll and/or said anvil roll (21) and the pressure at which said blade (2) is pressed onto said sheets.

10. A heat-bonding apparatus according to claim 9, comprising: first temperature setting means for setting the temperature of said heat-bonding blade (2) during the heat-bonding to a level which is lower than the temperature of said heat-bonding blade (2) during heat-cutting, second temperature setting means for setting the temperature of an anvil member (21) supporting said thermoplastic resin sheets during heat-bonding to a level which is higher than the temperature of said anvil member (21) during the heat-cutting; and pressure setting means for setting the pressure of said heat-bonding blade (2) to such a level as not to cause said thermoplastic resin sheets to be cut.

Patentansprüche

1. Warmschweißblatt (2) mit einer Kante (2a) zum Warmschweißen zweier oder mehrerer übereinanderliegender thermoplastischer Kunstharzlagen ohne sie durch Wärme zu zerschneiden, wobei die Kante (2a) des Blatts eine Kontaktfläche aufweist, die mit der obersten der thermoplastischen Kunstharzlagen in Kontakt bringbar ist, wobei die Kontaktfläche mit einer Prägung versehen ist, um eine Vielfalt geprägter Vorsprünge (2b) aufzuweisen, und wobei das Blatt (2) ein Preßglied (3) mit einem unteren Ende aufweist, das auf zumindest einer Seite des Blatts zum ausreichenden Zusammendrücken der thermoplastischen Kunstharzlagen vorhanden ist, um ein Warmverschweißen zu bewirken, wenn die Kante (2a) des Blatts in die Lagen gepreßt wird, so daß die Lagen während des Warmverschweißens durch das zumindest eine Preßglied mit einem vorgegebenen Druck zusammengedrückt werden, dadurch gekennzeichnet, daß das durch die folgende Formel angegebene Verbindungsflächenverhältnis zwischen 20 und 90% der

\[
\frac{(\text{Gesamtfläche der geprägten Vorsprünge})}{(\text{Gesamtfläche der Kontaktfläche})} \times 100
\]

liegt.

3. Warmschweißvorrichtung nach Anspruch 2, bei der die Gegenwalze (21) auf ihrer äußeren Umfangsfläche mit einem wärmebeständigen elastischen Material bedeckt ist.

4. Warmschweißblatt nach Anspruch 1 oder Vorrichtung nach Anspruch 2 oder 3, wobei das Preßglied (3) auf jeder Seite des Blatts (2) vorhanden ist.

5. Warmschweißblatt nach Anspruch 1 oder 4 oder Vorrichtung nach einem der Ansprüche 2 bis 4, wobei das Preßglied (3) aus einem wärmebeständigen elastischen Material hergestellt ist, so daß es sich durch seine Elastizität einer Vielfalt von Dicken der übereinanderliegenden Lagen anpassen kann.

6. Warmschweißblatt nach Anspruch 1 oder 4 oder Vorrichtung nach einem der Ansprüche 2 bis 4, wobei das Preßglied (3) aus einem wärmebeständigen Material hergestellt ist und für
eine Bewegung in Richtung auf die Kante des Blatts (2) und von ihr weg angebracht ist, wo-
bei das Blatt (2) ferner Mittel (4) zum Drängen des Preßglieds (3) in Richtung auf die Kante des Blatts (2) aufweist.

7. Warmwasserblatt nach Anspruch 1 oder 4 oder Vorrichtung nach einem der Ansprüche 2 bis 4, wobei das Preßglied (3) für eine Bewe-
gung in Richtung auf die Kante des Blatts (2) und von ihr weg angebracht ist, wobei das Blatt (2) ferner Mittel zum Festhalten des Preß-
glieds (3) in einer vorgegebenen Stellung aufweist.

8. Warmwasserblatt nach einem der Ansprüche 1 oder 4 bis 7, oder Vorrichtung nach einem der Ansprüche 2 bis 7, ferner aufweisend eine Kühleinrichtung (5) zum Kühlen des Preßglieds (3).

9. Warmwasservorrichtung nach einem der An-
sprüche 2 bis 8, wobei die Vorrichtung wahr-
weise auch in einer Warm- und/oder Kühleinrichtung, in der sie die thermoplastischen Kunstharzlagen warm schneidet und warmver-
schweißt, betreibbar ist durch Wahl der Heiz-
temperatur der Heizwalze und/oder der Gegen-
walze (21) und des Drucks, mit dem das Blatt (2) auf die Lagen gepreßt wird.

10. Warmwasservorrichtung nach Anspruch 9, mit einer ersten Temperatureinstellungsein-
richtung zum Einstellen der Temperatur des Warmwasserblatts (2) während des Warmver-
schweißens auf einen Wert, der niedriger als die Temperatur des Warmwasserblatts (2) während des Warm schneidens ist, einer zwei-
ten Temperatureinstellungseinrichtung zum Einstellen der Temperatur eines die thermoplastischen Kunstharzlagen während des Warm-
verschweißens abstützenden Gegenkörpers (21) auf einen Wert, der höher als die Tempe-
ratur des Gegenkörpers (21) während des Warm schneidens ist, und einer Druckeinstel-
lungseinrichtung zum Einstellen des Drucks des Warmwasserblatts (2) auf einen Wert, bei dem kein Zerschneiden der thermoplastischen Kunstharzlagen erfolgt.

Revendications

1. Lame (2) de thermosoudage comportant une arête (2a) pour souder sous l’effet de la cha-
leur deux ou plus de deux feuilles de résine thermoplastique superposées sans les couper sous l’effet de la chaleur, l’arête (2a) de ladite lame étant pourvue d’une surface de contact pouvant venir en contact avec la feuille supé-
rieure extrême desdites feuilles de résine ther-
mosplastique, ladite surface de contact étant gauffrée de manière à comporter une multiplicité de saillies (2b) de gaufrage et ladite lame (2) comprenant un élément de pression (3) comportant une extrémité inférieure et présent sur au moins un des côtés de ladite lame pour exercer sur lesdites feuilles de résine thermoplasticque une pression suffisante pour provo-
er un thermosoudage quand ladite arête (2a) de ladite lame s’encastrera sous l’effet de la pression dans lesdites feuilles, de telle sorte que lesdites feuilles soient soumises à une pression prédéterminée par ledit élément de pression au nombre d’au moins un pendant le thermosoudage, caractérisée en ce que le taux de superficie de soudage donné par la formule ci-après est compris entre 20 et 90%:

\[(\text{superficie totale des saillies de gaufrage})/\text{superficie totale de la surface de contact}) \times 100\]

2. Appareil de thermosoudage comprenant un rouleau de chauffage rotatif chauffé par un élément de chauffage présent sur sa périphé-
rie extérieure avec au moins une lame de thermosoudage (2) et un rouleau d’appui (21) destiné à coopérer avec ledit rouleau de chauffage pour bloquer entre ces rouleaux une pluralité de feuilles superposées de résine thermoplastique devant être thermosoudées mutuellement, ladite lame de thermosoudage (2) ayant une arête (2a) constituant une surface de contact pouvant venir en contact avec la feuille supérieure extrême desdites feuilles super-
posées de résine thermoplastique, ladite surface de contact étant gauffrée de manière à comporter une multiplicité de saillies (2b) de gaufrage et ladite lame (2) comprenant un élé-
ment de pression comportant une extrémité inférieure (3) et étant présent au moins sur d’un des côtés de la dite lame pour exercer sur lesdites feuilles de résine thermoplastique une pression suffisante pour provoquer un thermosoudage quand ladite arête (2a) de ladi-
te lame s’encastrera, sous l’effet de la pression, dans lesdites feuilles, de telle sorte que lesdi-
tes feuilles soient soumises à une pression prédéterminée par ledit élément de pression (3), au nombre d’au moins un, pendant le thermo-soudage, caractérisé en ce que le taux de superficie de soudage donné par la formule ci-après est compris entre 20 et 90%:

\[(\text{superficie totale des saillies de gaufrage})/\text{superficie totale de la surface de contact}) \times 100\]
3. Appareil de thermosoudage selon la revendication 2, dans lequel ledit rouleau d'appui (21) est recouvert sur sa surface périphérique d'un matériau élastique résistant à la chaleur.

4. Lame de thermosoudage selon la revendication 1 ou appareil selon la revendication 2 ou 3, dans lesquels ledit élément de pression (3) est présent sur chaque côté de ladite lame (2).

5. Lame de thermosoudage selon la revendication 1 ou 4 ou appareil selon l'une quelconque des revendications 2 à 4, dans lesquels ledit élément de pression (3) est formé d'un matériau élastique résistant à la chaleur, de telle sorte qu'il puisse s'adapter de lui-même, grâce à son élasticité, à une grande diversité d'épaisseurs de feuilles superposées.

6. Lame de thermosoudage selon la revendication 1 ou 4 ou appareil selon l'une quelconque des revendications 2 à 4, dans lesquels ledit élément de pression (3) est formé d'un matériau élastique résistant à la chaleur et est monté en vue d'un mouvement de va-et-vient par rapport à l'arête de ladite lame (2), ladite lame (2) comprenant, en outre, un moyen de poussée (4) pour pousser ledit élément de pression (3) vers ladite arête de ladite lame (2).

7. Lame de thermosoudage selon la revendication 1 ou 4 ou appareil selon l'une quelconque des revendications 2 à 4, dans lesquels ledit élément de pression (3) est monté en vue d'un mouvement de va-et-vient par rapport à l'arête de ladite lame (2), ladite lame (2) comprenant, en outre, un moyen pour fixer ledit élément de pression (3) à un endroit prédéterminé.

8. Lame de thermosoudage selon l'une quelconque des revendications 1 ou 4 à 7, ou appareil selon l'une quelconque des revendications 2 à 7, comprenant, en outre, un moyen de refroidissement (9) pour refroidir ledit élément de pression (3);

9. Appareil de thermosoudage selon l'une quelconque des revendications 2 à 8, ledit appareil pouvant fonctionner sélectivement également dans un mode de thermo-(soudage/sectionnement) dans lequel il sectionne et soude sous l'effet de la chaleur lesdites feuilles de résine thermoplastique, en sélectionnant la température de chauffage dudit rouleau de chauffage et/ou dudit rouleau d'appui (21) et la pression sous laquelle ladite lame (2) est prés-

10. Appareil de thermosoudage selon la revendication 9, comprenant : un premier moyen de réglage de température pour régler la température de ladite lame de thermosoudage (2) pendant le thermosoudage à un niveau qui est inférieur à la température de ladite lame de thermosoudage (2) pendant le sectionnement sous l'effet de la chaleur, un second moyen de réglage de température pour régler la température d'un élément d'appui (21) supportant lesdites feuilles de résine thermoplastique pendant le thermosoudage à un niveau qui est plus élevé que la température dudit élément d'appui (21) pendant le sectionnement sous l'effet de la chaleur; et un moyen de réglage de pression pour régler la pression de ladite lame de thermosoudage (2) à un niveau tel qu'il n'entraîne pas un sectionnement desdites feuilles thermoplastiques.